soft tissue rich of vessels and mechanoreceptors in the intercondilar notch should improve and get quicker the ligamentation of the tendon implants and not only.
Methods: ACL remnants were classified into 5 morphologic patterns: group 1, bridging between the posterior cruciate ligament and tibia; group 2, bridging between the intercondylar notch and tibia; group 3, partial rupture of the posterolateral bundle; grup 4, partial rupture of the anteromedial bundle; and group 5, no substantial ACL remnants. We checked 180 patients, foot-ball players (amatorial and professional) aged 13th–40th years old with a follow up from 6–30 months. 95 patients had ACL remnant preserving as more scar tissue as possible and graduated at time of surgery as covering 25, 50 % or at least 75 % of the tendon implant. 85 patients had classic reconstruction without remnant preserving.
All the patients were evaluated with subjectve and objective score (IKDC, KOOS, Lysholm), with clinically evaluation and with KT 1000 instrument immediately before surgery and at time of follow up; they also were evaluated by an MRI scan at 3, 6 months and 1 year post surgery. At 6 months after surgery the patients were evaluated by a isokinetic exam and proprioceptive balance.
Results: In patients with ACL remnant preservation we found a shorter period of articular inflammation (less swelling) in the first 4 weeks. At the last follow up good and excellent results rise to 98 % in the group with remnant preservation, instead of 93 % in the other group. On MRI there was significantly better results in terms of intensity of signal, revascularization of the graft and a results a better quality of ligament integration in patients with more of 50 % remnant preservation. At 6 months, we had not significant statistically difference in terms of isokinetic exams beetween the 2 groups, but we found an improvement in proprioceptive terms in the group with remnant preservation.
Conclusions: In our experience ACL remnants surely contributed to obtain knee stability and proprioception. Maintaining ACL remnants may help the new ligament integration and our patients to return faster at their favourite sports.
ACL remnant, Mechanoreceptors, Proprioception, Augmentation

P13-1659

Mechanical characterization of cruciate and collateral ligaments of human knee

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Objectives: To better understand knee biomechanics, the knowledge of the mechanical characteristics of cruciate and collateral ligaments is fundamental.
However, very few data are currently available in the literature and often these analyses are mainly focus on collateral ligaments only at one single deformation speed.
The aim of this study is to provide such missing information.
Methods: Medial and lateral collateral ligament and anterior and posterior cruciate ligaments from fresh frozen cadaver leg were analyzed in this study. Each ligament was accurately dissected from the specimen without removing the femur and the tibial bony attachment. Uniaxial tensile testing for each ligament was performed on a standard testing machine.
The bony attachments of each ligament were connected to the machine using flat roughened clamps (Fig. 1).
Three different crosshead speeds were considered: 0.1, 0.2, 0.4 mm/s.

Fig. 1 Machine setting

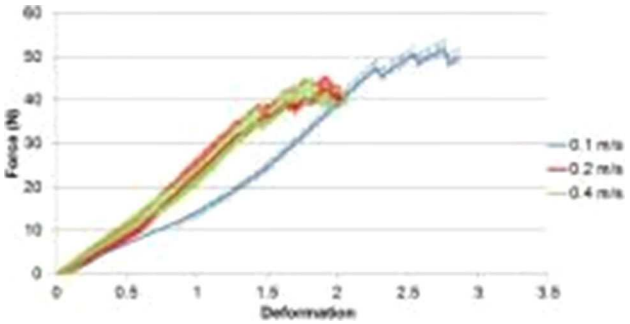

Fig. 2 PCL force/deformation curves depending on the used crosshead speed

For each speed, five repetitions for the same ligament were executed. Axial force and deformation were recorded continuously for each test.
Results: The average force/deformation curve and standard deviation for each analysed speed for the posterior cruciate ligament (PCL) is reported in Fig. 2.
Figure 2 shows how the ligament behaviour is speed dependent. A similar behaviour has been analysed for all the ligaments.
Figure 3 shows how each analyzed ligament has own mechanical characteristics for the same used crosshead speed (0.1 mm/s).
Conclusions: The mechanical behaviour in terms of force/deformation of several native knee ligaments was determined from experimental test. Results show that mechanical behaviour is speed dependent and that each ligament presents an own mechanical behaviour. As one of the challenges in TKA surgery appears to be designing soft tissue-friendly prostheses that will preserve the surrounding structures, this study wants to provide a better knowledge of normal knee function, in which the passive stability is the consequence of an extremely complex envelope of soft tissues around the joint structure and among them, collateral and cruciate ligaments provide the major stability.
ACl, PCL, MCL, LCL, Mechanical characterization

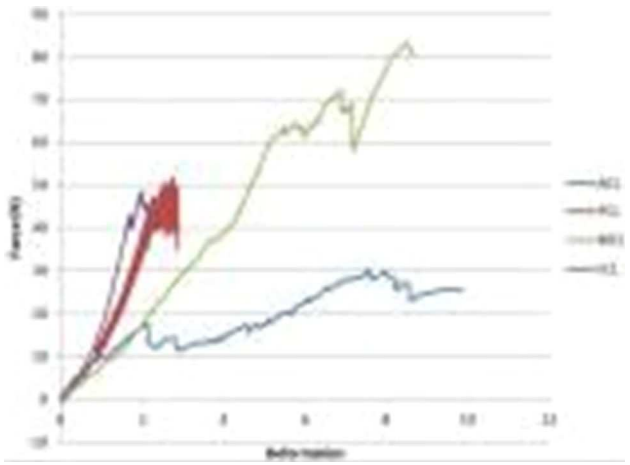

Fig. 3 Ligaments force deformation curves depending on the same used crosshead speed

P13-1683

Nonsurgical or surgical treatment of anterior cruciate ligament injuries: knee function, sports participation and knee reinjury. The Delaware–Oslo ACL cohort study

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Objectives: To evaluate knee function, sports participation and knee reinjuries over 2 years in ACL-injured patients who chose nonsurgical and those who chose surgical treatment.

Methods: This prospective cohort study included 143 ACL-injured patients. The patients were included within 3 months from injury, participated in pivoting sports at least twice per week, and were aged 13–60 years. Exclusion criteria were previous knee injury, bilateral injury, other grade III ligament injury, full thickness cartilage injury, and symptomatic meniscus injury. Isokinetic knee extension and flexion strength and self-reported knee function (IKDC 2000) were collected at baseline, 6 weeks and 2 years. Sports participation was reported monthly over 2 years using an online activity survey. Knee reinjuries were reported at follow-ups and in a monthly survey. Repeated ANOVA, GEE models and Cox regression with adjustment for age and preinjury sports participation were used to analyze group differences in functional outcomes, sports participation and knee reinjuries, respectively.

Results: The follow-up rates for all outcomes were >87 %. Surgically treated patients (n = 100) were significantly younger, more likely to participate in level I sports and less likely to participate in level II sports prior to injury than nonsurgically treated patients (n = 43, $p < 0.038$). There were no significant group by time effects in functional outcomes ($p > 0.165$). The crude analysis showed that surgically treated patients were more likely to sustain a knee reinjury [HR (95 % CI) 2.89 (1.02–8.13), $p = 0.045$] and to participate in level I sports in the 2nd year of the follow-up period [OR (95 % CI) 2.78 (1.40–5.52), $p = 0.004$]. After adjustment for age and preinjury sports participation, these differences were nonsignificant ($p > 0.317$); however, nonsurgically treated patients were significantly more likely to participate in level II sports the 1st year of the follow-up [aOR (95 % CI) 0.20 (0.12–0.34), $p < 0.001$], and in level III sports over the 2 years [aOR (95 % CI) 0.42 (0.19–0.94), $p = 0.035$]. After 2 years, 30 % of all patients had extensor strength, and 31 % had flexor strength values <90 % of the uninjured leg. 21 % of patients had self-reported knee function lower than the age- and sex-specific 15th ‰ of uninjured individuals, and 19 % experienced a knee reinjury.

Conclusions: There were few differences in the clinical course of nonsurgically and surgically treated ACL-injured patients in this prospective cohort study. Regardless of treatment course, a considerable number of patients have not fully recovered, and future work should focus on improving the outomes of these patients.

Anterior cruciate ligament, nonsurgical, surgical, treatment

P13-1685

Association of activity and fear with joint space width after anterior cruciate ligament reconstruction

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Objectives: Knee joint osteoarthritis (OA) is a common but poorly understood sequela of anterior cruciate ligament injury and reconstruction (ACLR). Radiographic joint space width (JSW) is one measure of articular cartilage thickness as well as knee OA [1], and differences between limbs occur after ACLR [2]. Risk of re-injury is highest with return to sport (RTS) within 1 year of ACLR [3], and activity level during this critical period may also lead to the development of OA. Fear of movement is associated with knee function after ACLR [4] and may be an additional factor affecting the development of OA. Therefore, the purpose of this study is to determine the relationship between activity level and fear early after ACLR with JSW differences between knees at 5 years.

Methods: Nineteen patients (5 females, 14 males, mean age 27.1, SD 9.3) with acute, unilateral ACL injury were included in this prospective study. Patients completed the Tampa Scale for Kinesiophobia (TSK-11) and reported cutting and pivoting activity level at 6 and 12 months after ACLR. Clearance to RTS after ACLR was determined using a battery of clinical tests [5]. Weight-bearing posterior-anterior (PA) bent knee (30°) radiographs were taken 5 years after ACLR. Minimal JSW (mJSW) was measured manually using computer software (SigmaView) in the involved medial and lateral compartment and at the same relative locations in the uninvolved knee [6]. mJSW difference (mm) (involved-uninvolved) was used from the compartment with the greater difference.

T tests were performed to test mJSW difference between patients who had and had not returned to pre-injury activity level and between sex. Correlational analysis was performed to test the relationship between TSK-11 scores, age, and body mass index (BMI) with mJSW difference. A priori significance level was set at $p < 0.05$.

Results: mJSW difference was greater in 9 involved medial compartments (mean −1.59, SD 1.50) and 9 involved lateral compartments (mean −1.47, SD .95) while equal in one patient (−1.40). No significant association was present between mJSW difference and sex ($p = .348$), age ($p = .457$), BMI ($p = .890$), time to RTS ($p = .532$) or whether patients had returned to pre-injury activity level at 6 months ($p = .185$) or 12 months ($p = .622$). A significant relationship was present between the TSK-11 and mJSW difference at 12 months ($p = .045$, $r = -.466$, mean 15.0, SD 4.0) but not at 6 months ($p = .084$, $r = -.406$, mean 16.6, SD 5.2).

Conclusions: Activity level 6 and 12 months post-operatively were not associated with greater involved joint space narrowing. However, mean differences were >1 mm irrespective of return to pre-injury activity level, and may be clinically important in the progression of knee OA. Differences in articular cartilage thickness may be more sensitive to biomechanical and joint loading measures than activity types. Higher fear of movement, represented by greater TSK-11